

# Laboratory Toxicity Studies in Response to the TVA Kingston Fossil Plant Fly Ash Spill

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- **Assess dredging and dewatering effects on surface water biota**

- Elutriate Toxicity – 3 species 24 tests
- Dredge Plume Toxicity – 2 species 46 tests
- Stilling Pond Discharge Toxicity – 2 species 48 tests

- **Characterize effects of ash on benthic biota**

- Whole Sediment Toxicity – 5 species 18 tests

- **Assess dredging and dewatering effects on surface water biota**
  - Elutriate – 17 of 24 tests – no toxicity
  - Dredge Plume – 46 tests – no toxicity
  - Stilling Pond Discharge – 47 of 48 tests – no toxicity
- **Characterize effects of ash on benthic biota**
  - Whole Sediment – 14 of 18 tests – no toxicity

- Dredging and dewatering does not result in toxicity to surface water biota
- Only 1 benthic species (*Hyalella azteca*) exposed to ash from the Emory River consistently exhibits effects from exposures to fly ash
- Laboratory observations of *H. azteca* exposures indicate possible physical effects

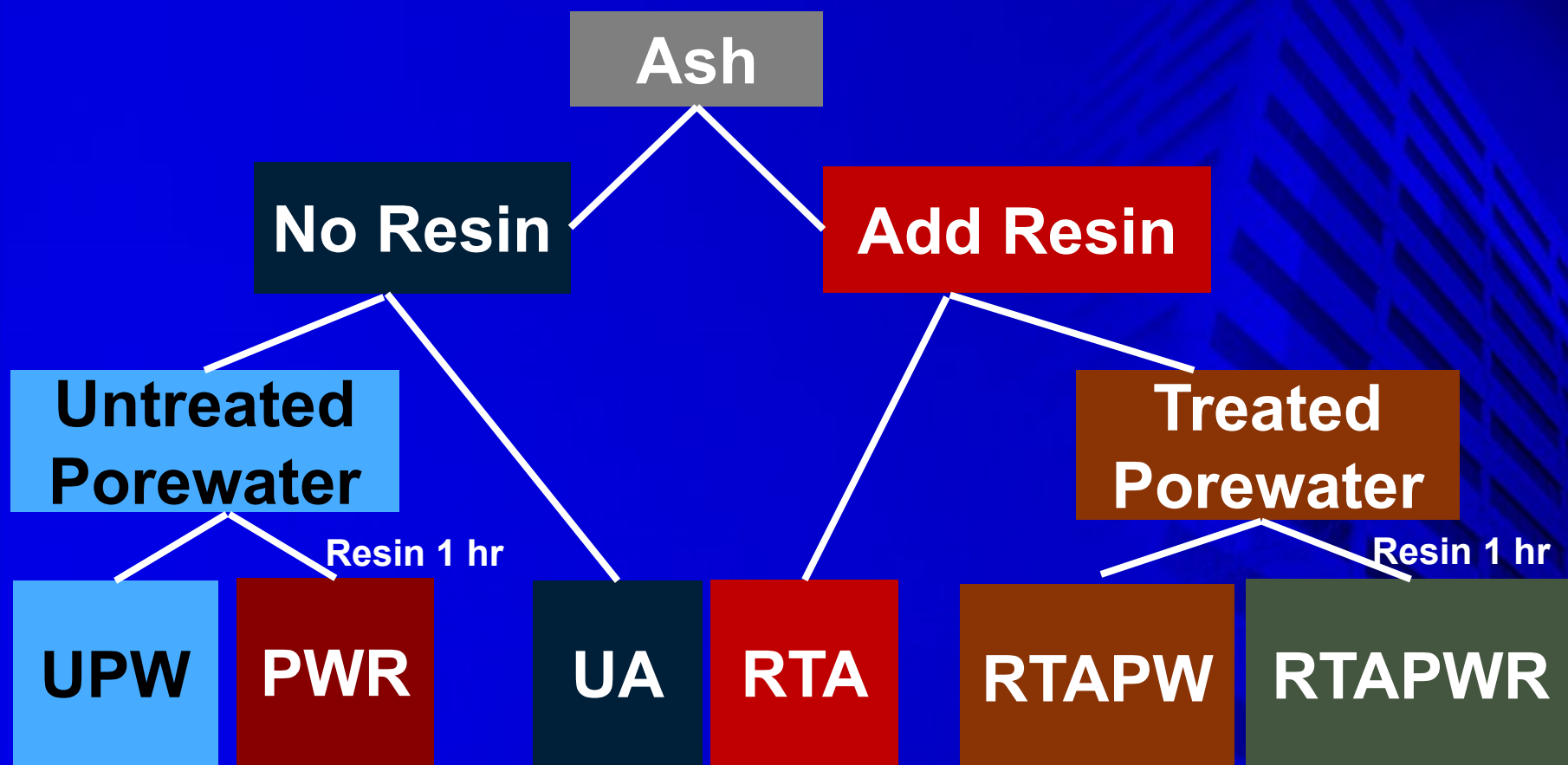


## Ash Is Unlike Natural Sediments

- Ash compacts in sample and exposure containers
- Porewater surfaces during sample storage
- Homogenization is problematic
- Laboratory benthic species unable to burrow in test exposures



# Resin Study Design



# Resin Study Conclusions

- Resin continually decreases Sb, As, Se more than other metals in ash over time
- Resin treatment of ash eliminates toxicity for *H. azteca* growth but not survival
- Resin decreases partitioning of Sb, As, Mo, Se, V to porewater and overlying water
- Resin treatment of porewater eliminates toxicity for *H. azteca* growth and survival



# Long-term Exposure Test Species



*Ceriodaphnia dubia*



*Chironomus dilutus*



*Hyaella azteca*



# Long-term Exposure Sediment Toxicity Study Design

## *H. azteca*

(8 site samples)  
**10-day Survival & Growth**  
(screening)

(4 site samples)  
**28-day Survival & Growth Test**  
(definitive)

## *C. tentans*

(8 site samples)  
**10-day Survival & Growth**  
(screening)

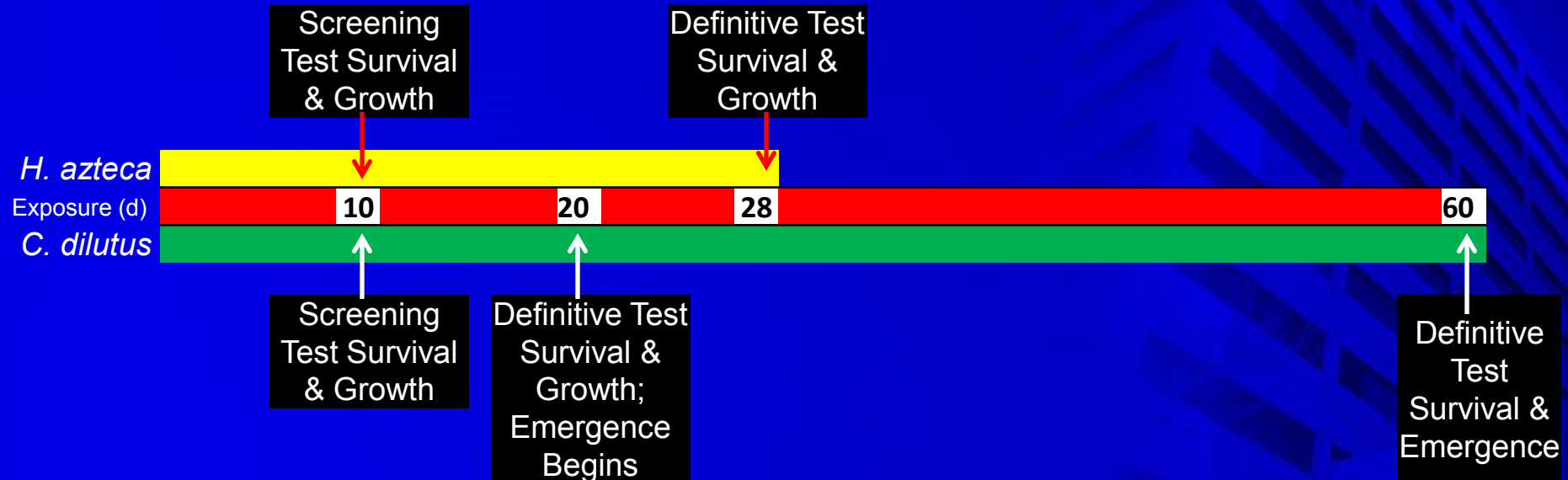
(4 site samples)  
**PLC Survival, Growth, & Emergence Test**  
(definitive)

## *C. dubia*

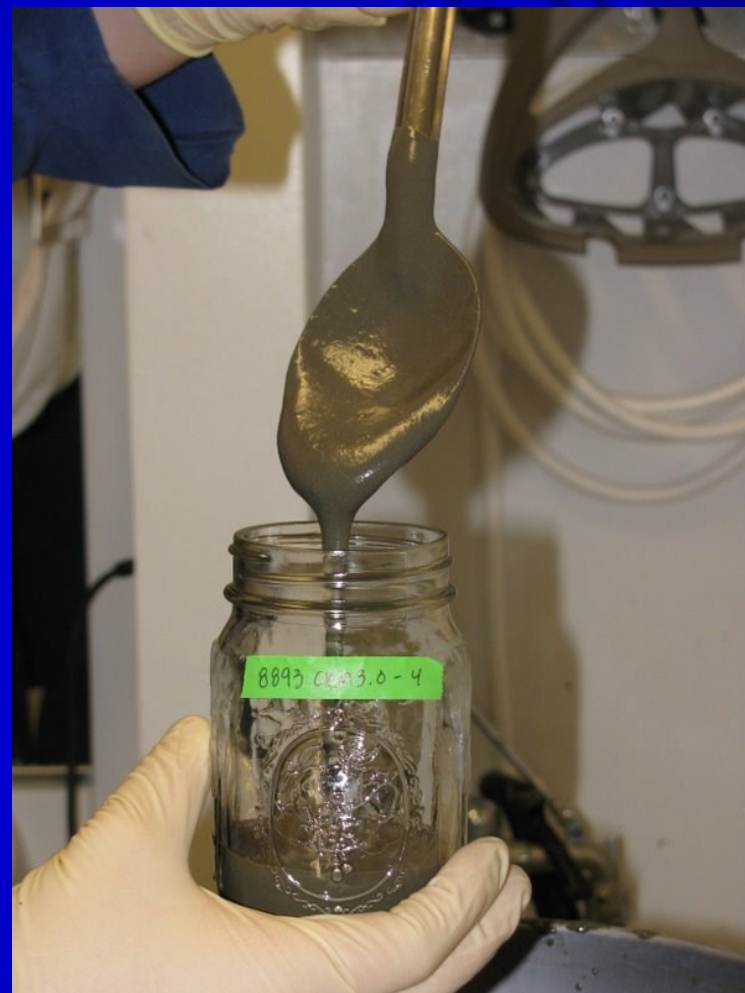
(8 site samples)  
**3-brood Survival & Reproduction Test (≈ 7 days)**  
(definitive)

- **Inhibition Concentration of 25% (IC<sub>25</sub>)**
  - *C. dubia* – 3-brood survival and reproduction
  - *H. azteca* – 28-d survival, growth, biomass
  - *C. dilutus* – 20-d survival, growth, biomass and partial life-cycle survival and emergence
- **Growth = total weight surviving / # surviving**
- **Biomass = total weight surviving / # initial**

# Timeline and Endpoints: Screening and Definitive Tests



# Sampling-Transportation-Processing Logistics





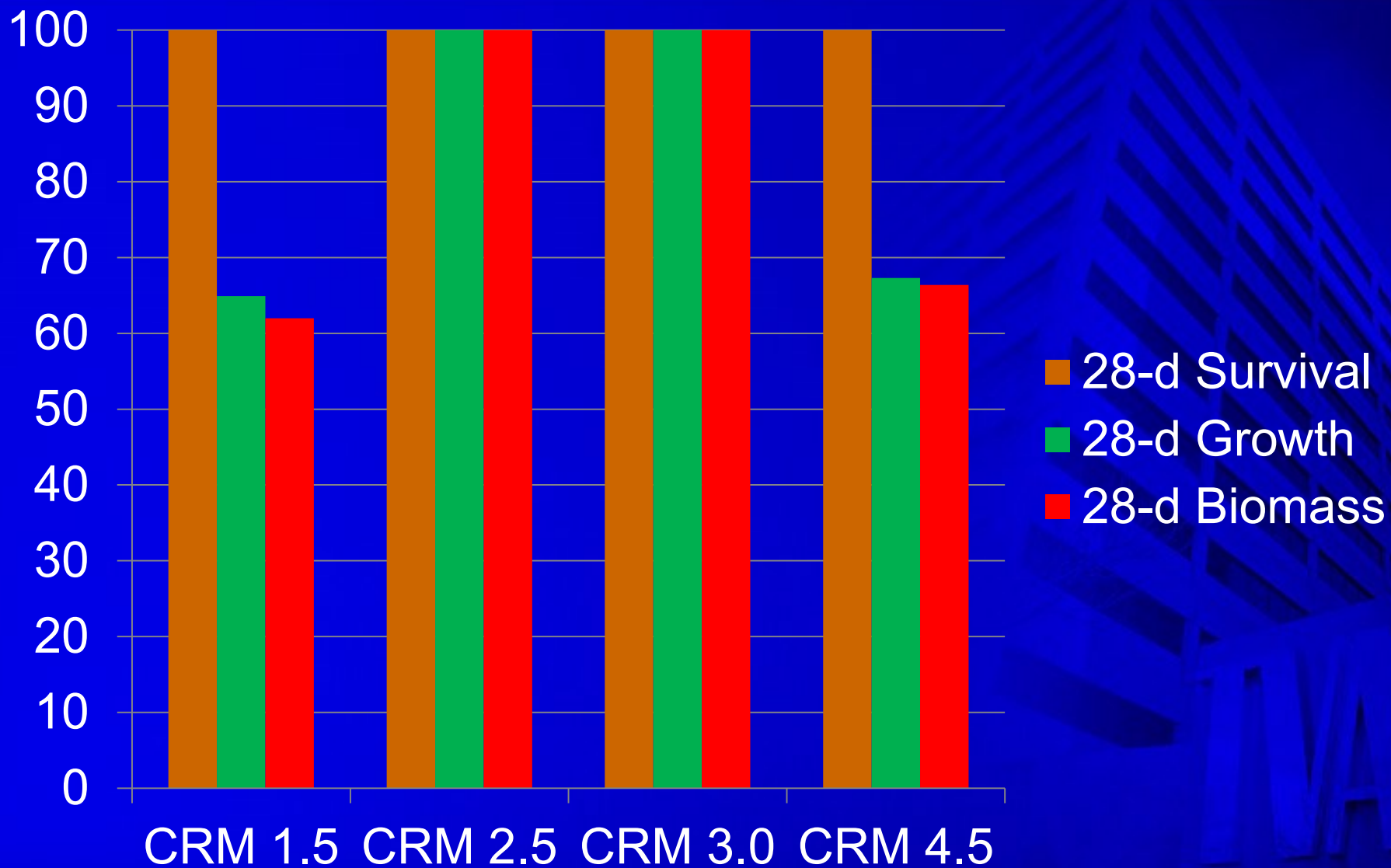
# Long-term Exposure Toxicity Results

## *Ceriodaphnia dubia*

- Clinch River – no effects on survival or reproduction
- Emory River – no effects on survival or reproduction

# Clinch River

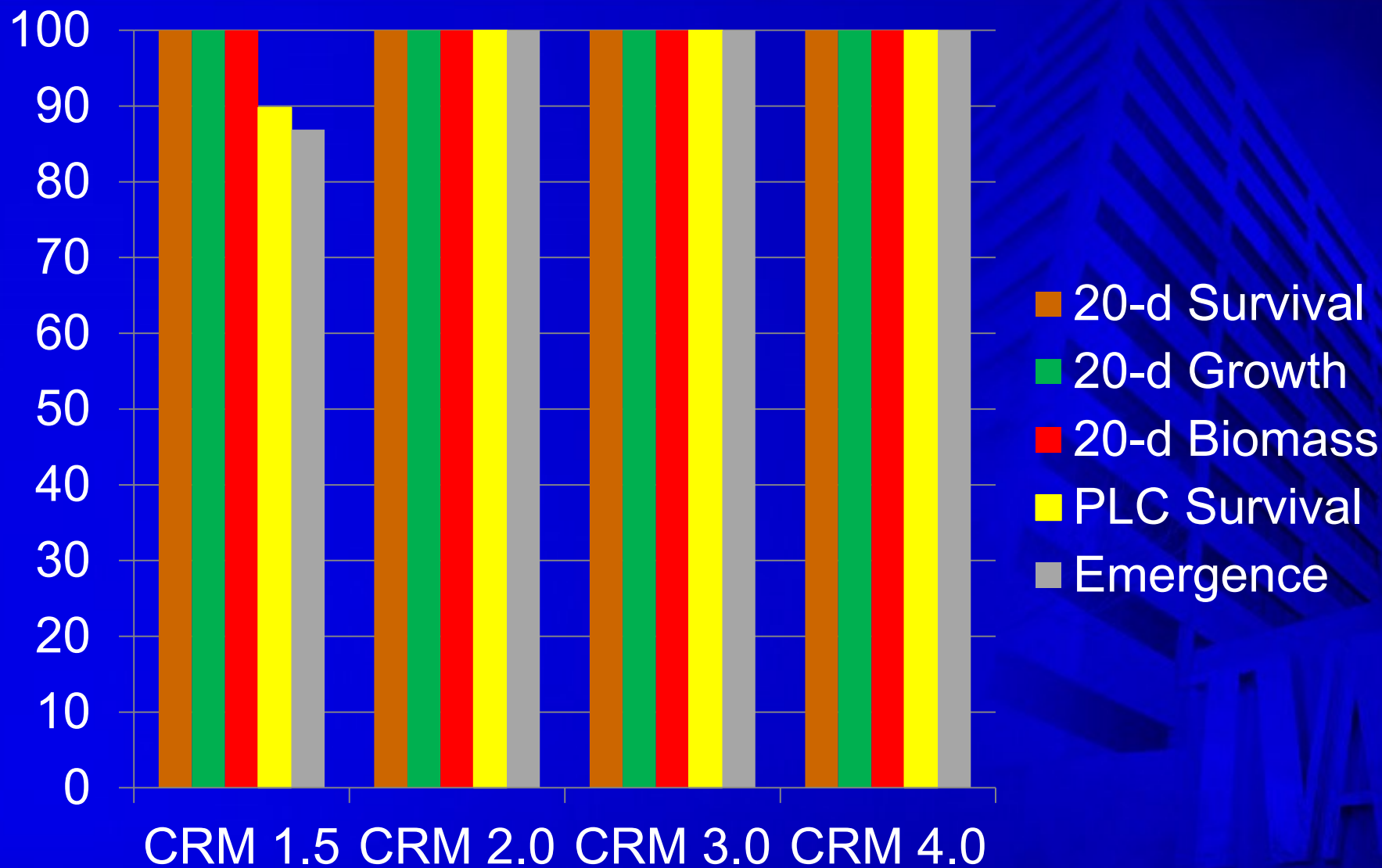
## *Hyalella azteca* IC<sub>25</sub> Values (%)





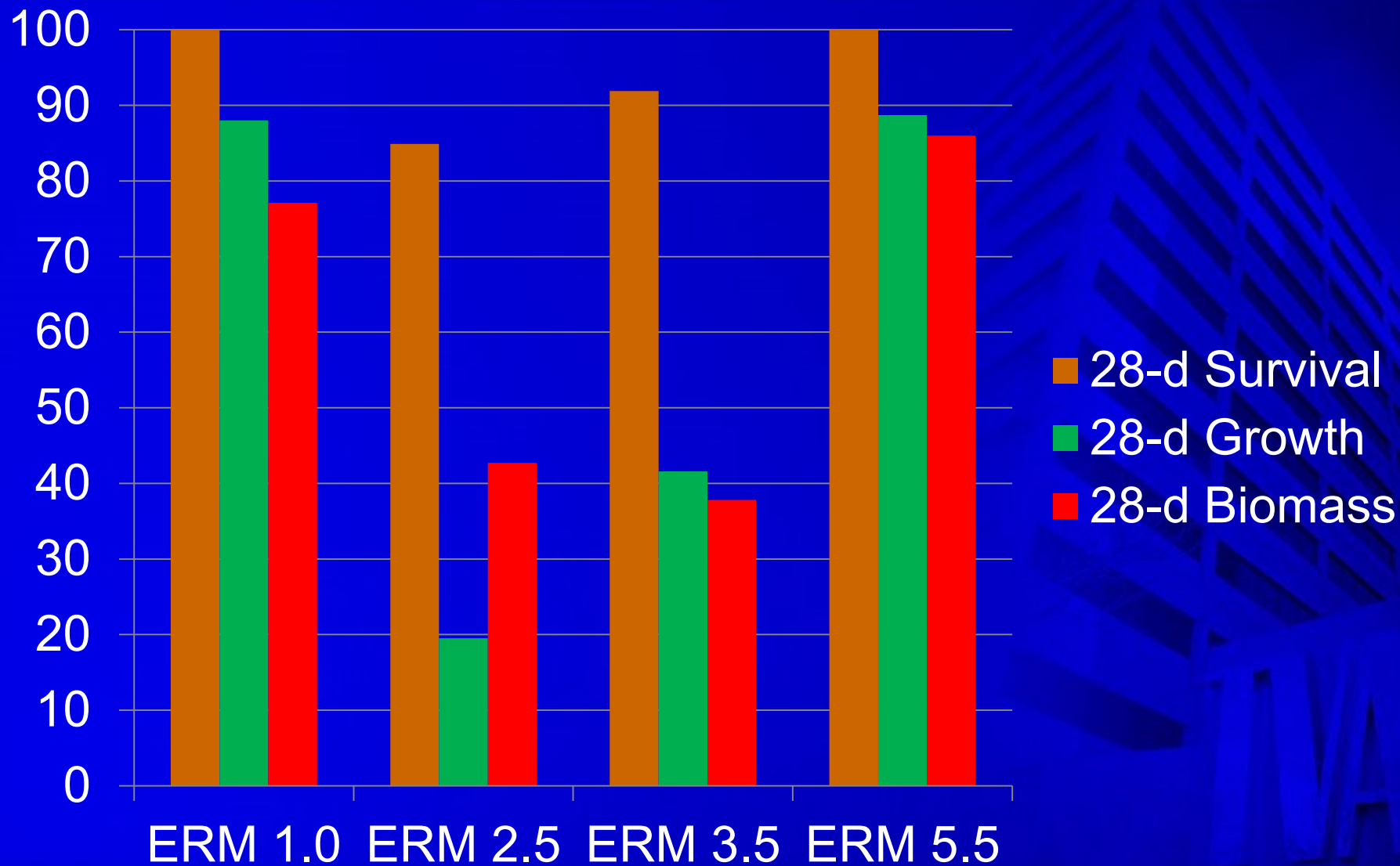
# Clinch River

## *Chironomus dilutus* IC<sub>25</sub> Values (%)



# Emory River

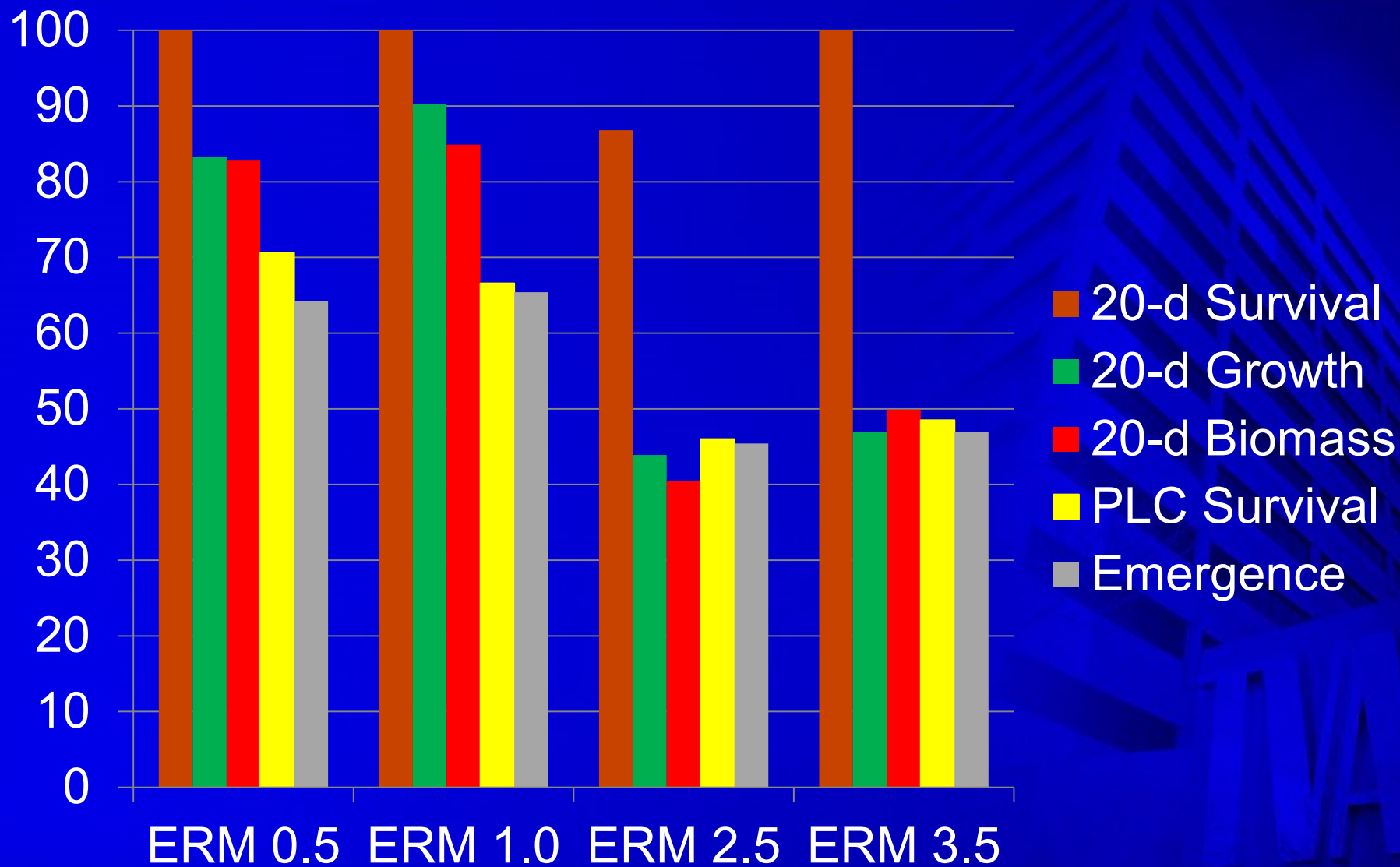
## *Hyalella azteca* IC<sub>25</sub> Values (%)





# Emory River

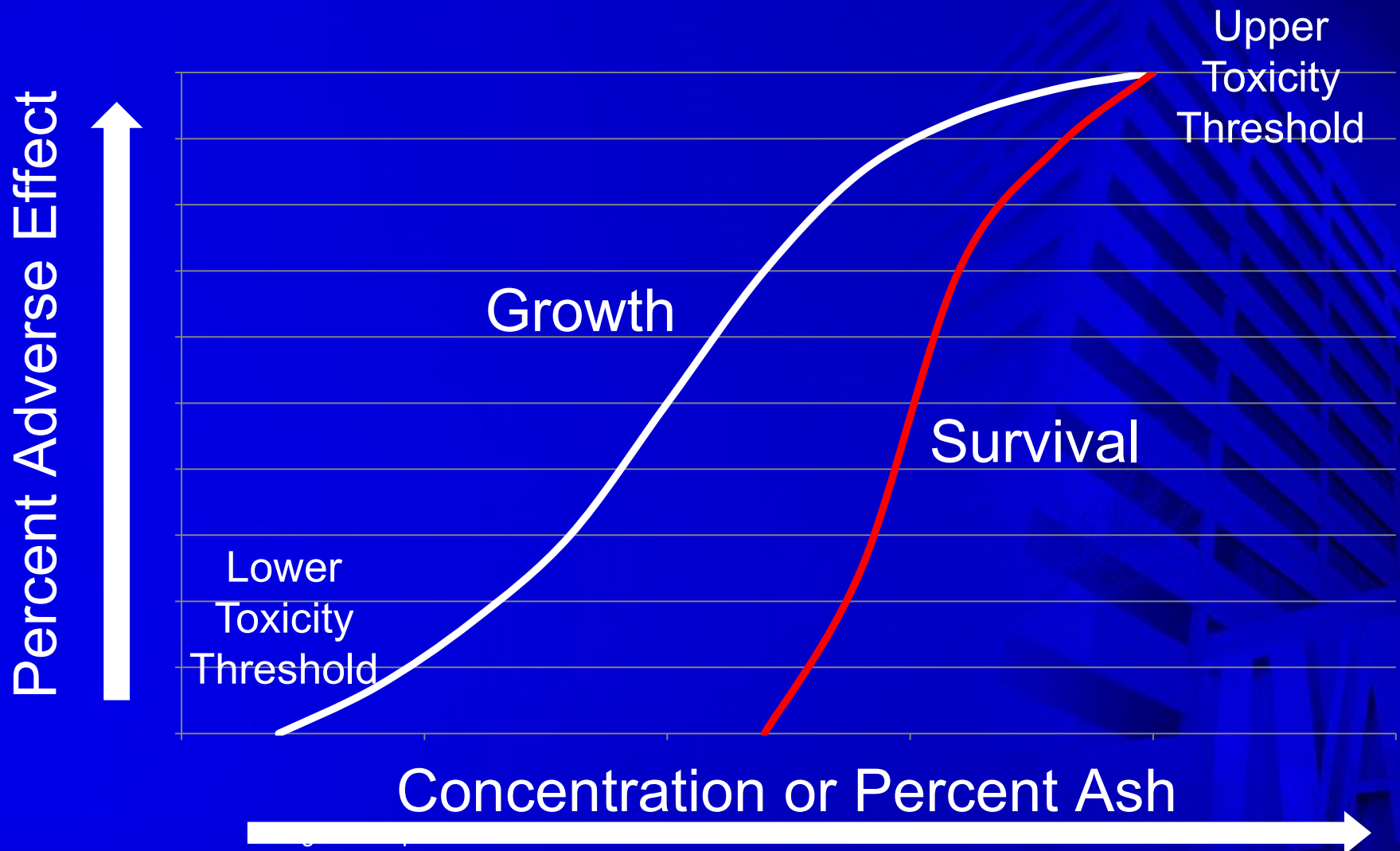
## *Chironomus dilutus* IC<sub>25</sub> Values (%)



# Long-term Exposure Conclusions

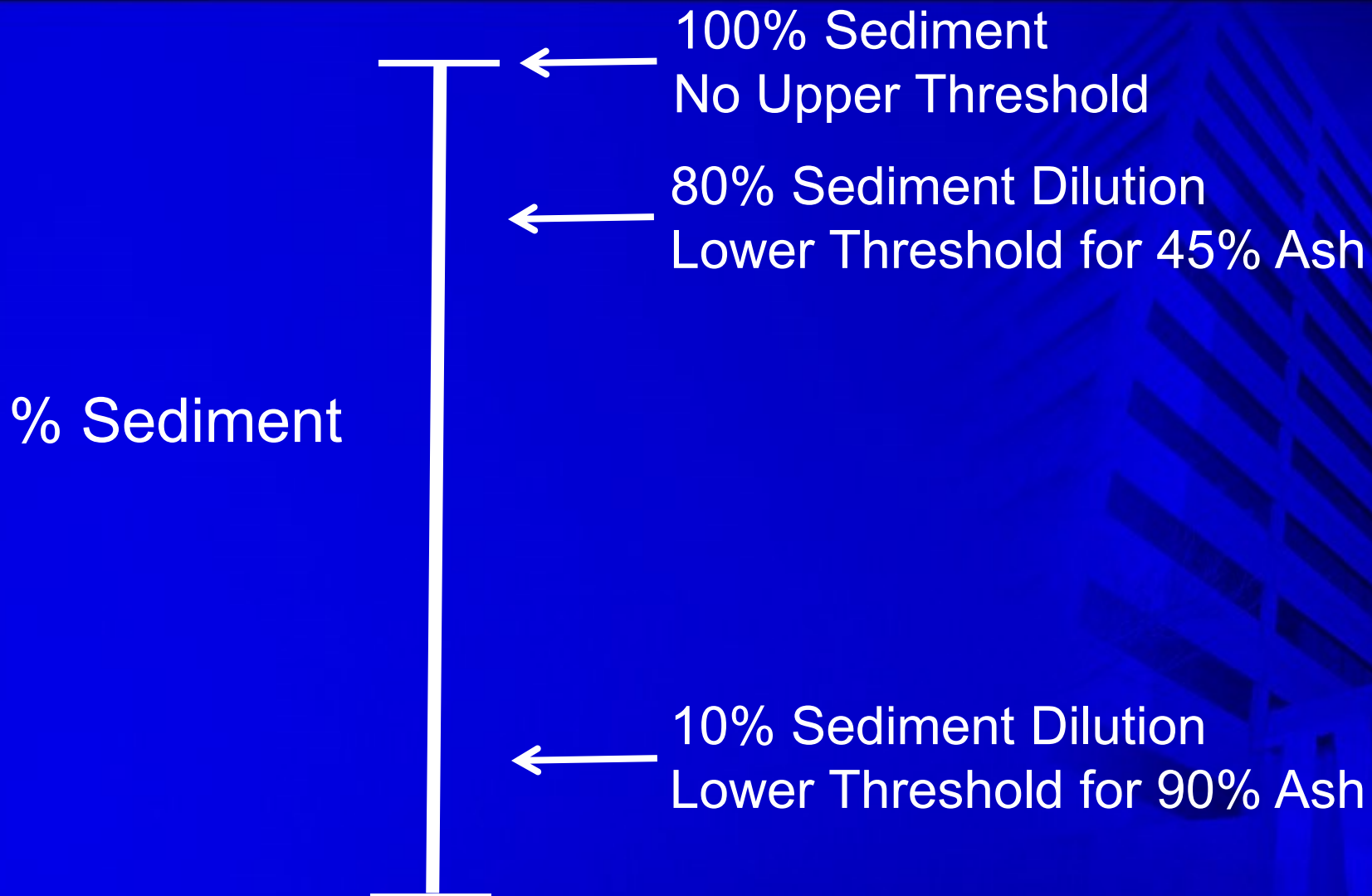
- Surface water invertebrates inhabiting the sediment-water interface are not at risk
- Minor effects observed in Clinch River exposures not attributed to ash
- *H. azteca* and *C. dilutus* exposures to Emory River sediments with > 40-50% ash suggest moderate risks

# Long-term Exposure Summary: Example of Exposure-Response Curves





# Long-term Exposure Summary: The Importance of Ash Content





# Long-term Monitoring Plan Sediment Toxicity Sampling

- Sample collection: 2013 & 2017
- ERM 6.0 (reference)
- ERM 1.0 (known ash deposits)
- CRM 8.0 (reference)
- CRM 3.0 (known ash deposits)
- Overbank areas only with suitable habitat

# Long-term Monitoring Plan Laboratory Toxicity Testing

- *H. azteca* 10-day Survival & Growth Test
- Definitive (0, 20, 40, 60, 80, 100% )
- River reference sample results compared to laboratory sediment sample results
- ERM 1.0 and CRM 3.0 sample results compared to river reference sample results
- River water used in all tests

# Laboratory Acknowledgements

